

DIGITAL-BROADCAST RECEIVING APPARATUS AND METHOD

BACKGROUND OF THE INVENTION

Field of the Invention

5 The present invention relates to a digital-broadcast receiving apparatus and method, particularly to digital-broadcast receiving apparatus and method for demodulating and filtering a plurality of programs data.

10 Description of the Related Art

 A program filter used for a conventional digital-broadcast receiving apparatus filters a single carrying stream input from one demodulating circuit and transfers a filtered result to an image-and-sound decoder to reproduce sounds and images. For
15 example, the format of a transport stream in the standard ISO/IEC 13818-1 (MPEG-2) decided by ISO (International Organization for Standardization) is known as the format of a single carrying stream. In case of the transport stream, a plurality of programs are included in one stream and moreover, programming for telecast
20 and an extension function such as a scramble function are included.

 Moreover, in case of a conventional program filter, when data to be output occurs as a result of filtering, output of the data is requested for an outside user to interrupt the program of the
25 outside user.

Furthermore, to filter a plurality of carrying streams by using a conventional program filter, carrying streams output from different demodulating circuits are filtered by different program filters. Then, each program filter has its own memory buffer and stores a filtered result in each memory buffer.

Furthermore, a conventional program filter does not transfer any filtered result to another unit again through a network.

Furthermore, a conventional program filter outputs a new packet or a payload included in the packet whenever the packet arrives regardless of whether the information carried by a packet included in each carrying stream is table-type information, combined-table-type information, or stream-type information.

The above conventional program filters have the problems described below.

A first problem is that, because a conventional program filter is configured by so as to filter a single carrying stream input from one demodulating circuit, it is not suitable for the case in which a plurality of programs are simultaneously filtered and spooled in parallel.

A second problem is that, because a conventional program filter is configured so as to request an outside user to output data from the program filter side and wait for a permit when filtered-result data is ready for output, it is necessary for a user-side program to interrupt other processing and transfer requested data.

A third problem is that, to filter a plurality of carrying streams by using a conventional program filter, each program filter has its own memory buffer and therefore, a memory working efficiency lowers or a memory capacity increases.

5 A fourth problem is that it is impossible for a conventional program filter to packet-divide a filtered result again and transfer packet-divided filtered results to another unit via a network.

10 A fifth problem is that, because a conventional program filter is configured so as to output a packet ID recorded in the packet of each carrying stream when the packet ID matches a designated packet ID, it is necessary to decode a plurality of carrying streams and search a related packet ID whenever a packet ID cannot be directly detected.

15 A sixth problem is that, because a conventional program filter buffers filtered information on a memory independently of whether the filtered information is table-type information, combined-table-type information, or stream-type information, table-type data is redundantly and repeatedly written in the
20 memory and resultantly the memory consumption increases.

A seventh problem is that it is necessary for a user to change settings of a demodulating circuit in a conventional program, when the information designated by the user is not present in a carrying stream.

25 An eighth problem is that, because a plurality of

conventional program filters respectively correspond to demodulating circuits one to one, it is impossible to make the setting of a certain program filter suitable for a carrying stream sent from another demodulating circuit which does not originally
5 correspond to the setting.

SUMMARY OF THE INVENTION

Object of the Invention

It is an object of the present invention to provide a program
10 filter making it possible to simultaneously filter a plurality of carrying streams in parallel.

Summary of the Invention

To attain the above object, the present invention
15 temporarily stores results of filtering a plurality of carrying streams in a buffer memory and transfers filtered results from the buffer memory to a user-side unit, when any transferring request from the user-side unit is received.

In FIGS. 1 and 2, a program filter of the present invention
20 is provided with a packet filter 11 for receiving an input from each demodulating circuit (2) and extracting only the necessary information designated by a user therefrom and a memory interface 12 for writing an output of the packet filter 11 in a memory buffer 3. The packet filter 11 judges whether the packet ID of each packet
25 in a carrying stream serving as an output of a demodulating circuit

coincides with a previously entered packet ID and passes the packet when the former packet ID coincides with the latter packet ID. The memory interface 12 writes a packet passing through the packet filter 11 in the memory buffer 3. A user reads a filtered result by accessing the memory buffer 3.

That is, when a plurality of carrying streams are filtered by a single program filter, filtered results are temporarily stored in a memory buffer and the results are transferred in accordance with a request from a user. Thus, it is possible to handle requests from a plurality of users or from processes or threads on a plurality of host processors by distinguishing between them. Moreover, it is possible to output a filtered result in accordance with the condition of a user-side program and it is unnecessary to other program of the user side.

In the case of the present invention, because a buffer memory is configured by a single memory space, the frequency for assigning an excessive memory area to each carrying stream is decreased and it is possible to improve the working efficiency of a memory and reduce the capacity of the memory.

The present invention makes it possible to access one buffer memory by storing filtered results in a buffer memory through time-sharing.

The present invention makes it possible to packet-divide the data obtained as a result of filtering again by temporarily storing the header information of each packet passing through a

filter and thereafter reusing the information. Thereby, it is possible to transfer a filtered result via a network.

The present invention makes it possible to reduce a memory capacity required to store table-type information by distinguishing between table-type information and stream-type information and always overwriting the table-type information with newly arriving information.

The present invention stores combined-table-type information in a memory buffer by separating it from table-type information or stream-type information. Thus, it is possible to reduce a necessary memory capacity compared to a case of storing combined-table-type information as stream-type information. Moreover, by separately retrieving one piece or a plurality of pieces of table-type information configuring combined-table-type information, it is possible to reduce the amount of data to be transferred to an outside user and improve the convenience.

The present invention automatically filters and stores related program information by keeping and controlling a program-information table in a program filter. By using filtered program information, it is possible to update the program-information table and thereby, a program-information table according to the latest information is always generated.

The present invention makes it possible to convert a program ID designated by a user into a packet ID by referring to a program-information table and filter a carrying packet by using

the packet ID obtained as a result of conversion.

The present invention makes it possible to judge in a program filter whether the information requested by a user can be obtained from a carrying stream by referring to a program-information table.

5 Moreover, by referring to the program-information table, it is possible for a program filter to automatically change settings of a demodulating circuit and possible to output the carrying stream necessary for the demodulating circuit.

10 The present invention makes it possible to apply a certain filtering condition to an optional carrying stream by making it possible to set respective filtering conditions independently of the carrying stream. Thereby, it is possible to apply a filtering condition once set a carrying-stream output of a demodulating circuit not used at that point of time and reduce the throughput
15 for setting filtering conditions.

BRIEF DESCRIPTION OF THE DRAWINGS

This above-mentioned and other objects, features and advantages of this invention will become more apparent by
20 reference to the following detailed description of the invention taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is an illustration showing an embodiment of a digital-broadcast receiving apparatus mounting a program filter of the present invention;

25 FIG. 2 is a block diagram showing a first embodiment of a

program filter of the present invention;

FIG. 3 is an illustration showing a plurality of carrying streams output from a plurality of demodulating circuits;

FIG. 4 is an illustration showing an internal configuration of a packet configuring a carrying stream;

FIG. 5 is an illustration showing a configuration of the header of the packet in FIG. 4;

FIG. 6 is a flow chart showing the processing procedure of the packet filter of the first embodiment of the present invention shown in FIG. 2;

FIG. 7 is a block diagram showing the hardware configuration of the packet filter of the first embodiment of the present invention shown in FIG. 2;

FIG. 8 is a block diagram showing a configuration of a memory interface of the first embodiment of the present invention;

FIG. 9 is an illustration showing a configuration of the memory buffer in FIG. 8;

FIG. 10 is an illustration showing another configuration of the memory buffer in FIG. 8;

FIG. 11 is a block diagram showing the configuration of a program filter of a second embodiment of the present invention;

FIG. 12 is a block diagram showing the configuration of a program filter of a third embodiment of the present invention;

FIG. 13 is a block diagram showing the configuration of a program filter of a fourth embodiment of the present invention;

FIG. 14 is a block diagram showing the configuration of a program filter of a fifth embodiment of the present invention;

FIG. 15 is a block diagram showing the configuration of a program filter of a sixth embodiment of the present invention;

5 FIG. 16 is a block diagram showing the configuration of a program filter of a seventh embodiment of the present invention;

FIG. 17 is a block diagram showing the configuration of a program filter of an eighth embodiment of the present invention;

10 FIG. 18 is a block diagram showing the configuration of a program filter of a ninth embodiment of the present invention;
and

FIG. 19 is an illustration showing a configuration of a filter-setting-parameter storing memory of a tenth embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiments of the present invention will be described below by referring to the accompanying drawings.

20 FIG. 1 is an illustration showing a configuration of a digital-broadcast receiving apparatus of the present invention. Referring to FIG. 1, digital carrying streams are demodulated by a plurality of demodulating circuits 2 and outputs of the demodulating circuits 2 are input to a program filter 1. The program filter 1 extracts only the data to be recorded and
25 reproduced out of a plurality of input carrying streams and

outputs the data to the memory buffer 3. The data supplied to a recording/reproducing circuit 4 via the memory buffer 3 is recorded in a recording medium 5 in accordance with a designation of a user and directly transferred to a decoder 6. The data recorded in the recording medium 5 is transferred to the decoder 6 via the recording/reproducing circuit 4 in accordance with a designation of a user.

The data transferred to the decoder 6 is converted into a format usable by the user or a format which can be obtained by the user in audiovisualable manner through a display 7 and a loudspeaker 8 and an output of the decoder 6 is provided for the user through the display 7 and loudspeaker 8.

This embodiment makes it possible to provide the information obtained via a plurality of demodulating circuits 2 for a plurality of audiences (users) via a plurality of displays.

The apparatus shown in FIG. 1 is configured so as to temporarily record data in the recording medium 5. Moreover, it is possible to provide the information obtained via a plurality of demodulating circuits 2 in a device without any recording medium 5 for a plurality of audiences (users).

It is also permitted to use a configuration provided with either of the display 7 and loudspeaker 8 or use an optional unit capable of providing information for a user in the form of a format desired by the user as an output unit.

FIG. 2 is an illustration showing the configuration of the

first embodiment of the program filter 1. In FIG. 2, the program filter 1 is provided with a plurality of packet filters 11 for using outputs of a plurality of demodulating circuits 2 as inputs and extracting only the necessary information according to a designation of a user from the inputs and a plurality of memory interfaces 12 for writing outputs of a plurality of packet filters 11 in the memory buffer 2.

FIG. 3 is an illustration for explaining a plurality of carrying streams output from a plurality of demodulating circuits 2 and input to the program filter 1.

In FIG. 3, a carrying stream output from each demodulating circuit 2 is configured by a plurality of packets 101 arranged on a time base. FIG. 3 shows a mode in which there is no vacant slot between two consecutive packets (continuous). However, it is also permitted to insert a vacant time slot between two consecutive packets.

FIG. 4 is an illustration showing a packet format of each packet 101 shown in FIG. 3. In FIG. 4, the packet 101 is configured by a header 102 and a payload 103.

FIG. 5 is an illustration showing a format of the header 102 of the packet shown in FIG. 4. In FIG. 5, the header 102 includes a packet ID 104 showing the type of the information carried by each packet 101.

FIG. 6 is a flow chart showing the processing procedure of the packet filter 11 of the first embodiment of the program filter

1 shown in FIG. 2.

Referring to FIG. 6, the packet 101 is input to the packet filter 11 (step 201) to judge whether a packet ID matches the packet ID 104 of the input packet 101 is entered in the packet filter 11 (step 202). In step 202, when a matched packet ID is entered, step 203 is started but when no matched packet ID is entered, step 201 is restarted.

In step 203, the payload portion 103 of the packet 101 is transferred to a memory buffer 3 and step 201 is restarted.

In case of the flow chart shown in FIG. 6, a program filter 1 transfers the payload 103 of the packet 101 to a memory buffer 3. However, it is also permitted to use a configuration for transferring not only the payload 103 but also a part or the whole of a header 102 to the memory buffer 3.

FIG. 7 is an illustration showing the configuration of the packet filter 11 of the program filter 1 of the first embodiment shown in FIG. 2.

In FIG. 7, a carrying stream output from the demodulating circuit 2 is first input to a packet detecting circuit 27 and a packet 101 is separated.

The packet 101 is input to a packet-ID detecting circuit 22 and a timing adjustment FIFO (First In First Out memory) 23.

When the packet 101 is input to the packet-ID detecting circuit 22, the packet ID 104 of the packet 101 (see FIG. 5) is separated and output.

Outputs of the packet-ID detecting circuit 22 and outputs of a plurality of packet ID registers 21 are respectively compared by a packet ID comparator 24 and "1" (positive logic) or "0" (negative logic) is output as a comparison result in accordance with matching or mismatching between the both outputs.

Outputs of a plurality of packet ID comparators 24 are input to an OR circuit 25 and if an output "1" among outputs of the packet ID comparators 24 is output, the OR circuit 25 also outputs "1" .

When an output of the OR circuit 25 is equal to "1" , an output of a buffer 26 is enabled and an output of the timing adjustment FIFO 23 (packet) is transferred to the memory buffer 3.

For the packet filter 11 shown in FIG. 7, a case is described in which the packet 101 input via the timing adjustment FIFO 23 is directly output to the memory buffer 3. However, it is also permitted to exclude a part of the packet and transfer only the remaining packet to the memory buffer 3.

FIG. 8 shows the configuration of the memory interfaces 12 and memory buffer 3 of the program filter 1 shown in FIG. 2 in detail. In FIG. 8, a plurality of memory interfaces 12 respectively issue a buffer request to a memory controlling circuit 31 before outputting data to the memory buffer 3.

The memory controlling circuit 31 adjusts the competition between buffer requests output from a plurality of memory

interfaces 12 and performs transfer control for the memory interfaces 12 so that one memory interface 12 at most transfers data to the memory buffer 3.

Moreover, the memory controlling circuit 31 assigns a memory area to each filter output issuing a buffer request in the memory interfaces 12 and outputs an address of an assigned area to the memory buffer 3.

The memory interface 12 output data in accordance with the transfer control by the memory controlling circuit 31 and writes a filter output in the memory buffer 3.

According to the above processing, it is possible to write outputs of a plurality of packet filters 11 in the memory buffer 3 constituted of a single memory space without competition for writing data by controlling assignment of write areas on the memory 3.

FIG. 9 is an illustration for explaining assignment of areas of filter outputs on the memory buffer 3 in a program filter of the first embodiment. In FIG. 9, a write position and a read position (pointer) are present in an area 41 of the memory buffer 3. Moreover, filter outputs are first written in write positions in order of arrival and the number of write positions is increased in accordance with the length of written data. Furthermore, whenever data is output from the memory buffer 3, the number of read positions is increased in accordance with the length of output data and write and read positions are returned to the

embodiment. In FIG. 11, carrying streams serving as outputs of a plurality of demodulating circuits 2 or each packet configuring the carrying streams is input to filter interfaces 35. Then, when a packet arrives, each filter interface 35 requests a right of use of the filter 11 to a scheduler 32. The scheduler 32 adjusts competitive filter requests and gives a use permit to one filter interface 25.

A filter interface 36 to which the permission is given outputs a packet 101 to a packet filter 11.

The packet filter 11 filter-processes the input packet 101 in accordance with the filter control of the scheduler 32 and transfers a filter processing result to a memory interface 12.

According to the above processing, the packet filter 11 realizes a filter through the time-sharing processing for each packet.

Moreover, the time-sharing processing for storing a packet in a memory buffer 3 is realized by storing the packet in, for example, the memory buffer shown in FIG. 8.

FIG. 12 is an illustration showing a configuration of a program filter 1 configuring a third embodiment. In FIG. 12, outputs of a packet filter 11 are respectively input to a corresponding data reproducing circuit 33. The data reproducing circuit 33 extracts a payload 103 in each packet 101 of a carrying stream to reproduce and recover original data. Moreover, in this case, the circuit 33 extracts a parameter included in a header

102 of each packet 101.

Then, the circuit 33 stores the header 102 or a parameter included in the header 102 in a header storing area 311 via a memory interface 12 and also stores reproduced data in a data storing area 312 via the memory interface 12.

A packet re-dividing circuit 34 divides the data stored in the data storing area 312 into payloads again, re-constitute a header of each packet in accordance with headers and parameters stored in the header storing area 311, combines a generated payload with a header to generate packets, and successively outputs the generated packets.

According to the above processing, only necessary information is extracted from carrying streams output from a plurality of demodulating circuits 2 and carrying-streams are regenerated and output in accordance with extracted data.

FIG. 13 is an illustration showing a configuration of a program filter 1 configuring a fourth embodiment. Referring to FIG. 13, a memory interface 12 is configured by a FIFO buffer 51, a data distributing circuit 52, and a table updating circuit 53. The FIFO buffer 51 absorbs a delay due to processings by the data distributing circuit 52 and table updating circuit 53 and a shift of output timing of the packet filter 11.

The data distributing circuit 52 judges whether an output of the packet filter 11 is stream-type information or table-type information. When the circuit 52 judges that the output is the

stream-type information, it transfers the output to a stream-type information storing area. When the circuit 52 judges that the output is the table-type information, it transfers the output to the table updating circuit 53.

5 The table updating circuit 53 successively overwrites input information into a predetermined position of a table-type information storing area. According to the above processing, the table-type information is updated because new information is overwritten on old information whenever new information arrives
10 every a certain time interval.

FIG. 14 is an illustration showing a configuration of a program filter 1 configuring a fifth embodiment. Referring to FIG. 14, a memory interface 12 is configured by a FIFO buffer 51, a data distributing circuit 52, a table updating circuit 53, and
15 a table-type-information designating circuit 57. The FIFO buffer 51 absorbs a delay due to processings by the data distributing circuit 52 and table updating circuit 53 and a shift of output timing of a packet filter 11.

20 The data distributing circuit 52 judges whether an output of the packet filter 11 is stream-type information, table-type information, or combined-table-type information. When the circuit 52 judges that the output is the stream-type information, it transfers an output of the packet filter 11 to the stream-type information storing area. When the circuit 52 judges that
25 the output is the table-type information or combined-table-type

information, it transfers the output to the table updating circuit 53.

The table updating circuit 53 transfers input information to a predetermined position of the table-type information storing area when the information is the table-type information and inputs the input information to the table-type-information designating circuit 57 when the information is the combined-table-type information.

The table-type-information designating circuit 57 selects one piece of table-type information or a plurality of pieces of table-type information configuring a plurality of pieces of input combined-table-type information and passes it or them in accordance with a table designation by a user and transfers it or them to a corresponding table of a combined-table-type information storing area 307.

However, in stead of selecting one piece of table-type information or a plurality of pieces of table-type information configuring combined-table-type information before inputting it or them to the memory buffer 3, it is also permitted to temporarily transfer the combined-table-type information to the memory buffer 3 and then select one piece of table-type information or a plurality of pieces of table-type information out of the combined-table-type information when a user accesses the memory buffer 3.

FIG. 15 is an illustration showing a configuration of a

program filter 1 configuring a sixth embodiment.

Referring to FIG. 15, a memory interface 12 is provided with a FIFO buffer 51, a table updating circuit 53, and a packet-ID updating circuit 54. The FIFO buffer 51 absorbs a delay due to processing by the table updating circuit 53 and a shift of output timing of a packet filter 11. The table updating circuit 53 updates a program related table 303 and a program map table 304 in accordance with an arriving packet 101.

In this case, information carried by a packet having a predetermined packet ID is stored in the program related table 303. Information related to a packet ID of a packet for carrying the information of the program map table is included in the information carried by the packet.

The program map table 304 stores program information, that is, the information of a packet ID relating to a certain program.

The packet-ID updating circuit 54 reads a packet ID of a packet for carrying the information of the program map table stored in the program related table 303 and sets the packet ID to the packet filter 11. According to the above processing, a program information table constituted of the program related table 303 and program map table 304 is updated.

Incidentally, the program information table having two hierarchies of the program related table 303 and program map table 304 is shown above. However, it is also permitted to form the program information table with a single-hierarchy information

table, a program information table configured by three hierarchies or more, or a program information table in which the number of hierarchies depends on the contents of program information or a category.

5 FIG. 16 is an illustration showing a configuration of a program filter 1 configuring a seventh embodiment. Referring to the FIG. 16, the configuration in FIG. 16 is obtained by adding a data distributing circuit 52, a packet-ID retrieving circuit 55, and a program-related-information storing area 305 to the configuration shown in FIG. 15.

Differences between the above-described sixth embodiment and the seventh embodiment will be described below.

A program map table 304 stores a plurality of program discriminating IDs and packet IDs relating to the program discriminating IDs, which is formatted so that a plurality of packet IDs relating to a designated program discriminating ID can be retrieved, when the program discriminating ID is designated.

In case of a packet-ID retrieving circuit 55, a program discriminating ID is input from an external unit to retrieve a packet ID relating to an input program discriminating ID among the packet IDs stored in a program map table 304 and set a packet ID obtained as a result of retrieval to a packet filter 11.

A data distributing circuit 52 transfers the table-type information relating to the program related table 303 and program map table 304 to a table updating circuit 53 and outputs the program

related information relating to a designated program discriminating ID to a program-related-information storing area 305.

According to the above configuration, a carrying packet is filtered by using a program information table.

FIG. 17 is an illustration showing a configuration of a program filter 1 configuring the eighth embodiment. Referring to FIG. 17, an output of a packet-ID retrieving circuit 55, a mismatching-program-discriminating-ID carrying-stream designating circuit 56, and an event information table 304 are added compared to the configuration in FIG. 16. Differences between the seventh embodiment shown in FIG. 16 and the eighth embodiments are described below.

Referring to FIG. 17, when a program discriminating ID input to the packet-ID retrieving circuit 55 is not detected by a program map table 302, mismatching detection is output to start the carrying-stream designating circuit 56. When the mismatching detection is input, the carrying-stream designating circuit 56 detects a carrying-stream ID corresponding to a mismatching program discriminating ID from the event information table and outputs the carrying-stream ID to a demodulating circuit 2. Thus, it is possible for the demodulating circuit to set demodulating conditions so as to output the information corresponding to a designated program-discriminating ID. Further, an event information table 306 previously discriminates a packet ID of a

packet for carrying the information and the packet ID is set to the packet filter 11. Moreover, a value of the event information table 306 is updated by table update 53. Furthermore, a carrying-stream ID is an identifier for distinguishing one carrying stream from other carrying streams sent from a broadcasting station. By designating a carrying-stream ID to the demodulating circuit 2, a carrying stream designated by the carrying-stream ID is output.

Incidentally, in case of the above embodiment, it is assumed that the packet ID of the packet for carrying the information of the event information table 306 is previously discriminated. However, it is clear that the same effect can be also obtained by designating a packet ID via a hierarchical program information table by using a program map table or other table-type information.

FIG. 18 is an illustration showing a configuration of a program filter 1 configuring the ninth embodiment. Referring to FIG. 18, filter setting parameters corresponding to a plurality of packet filters present in the program filter 1 are set to a filter-setting-parameter storing memory 44 from an external unit.

A parameter transferring circuit 61 sets the parameters stored in the filter-setting-parameter storing memory 44 to their corresponding packet filters 11 in accordance with the filter designation input from an external unit. In this case, the filter designation includes the information showing which parameter

should be applied to a packet filter 11 among the parameters set to the filter-setting-parameter storing memory 44 and the information showing to a packet filter 11 to which the parameter should be applied among a plurality of packet filters 11 in case of application. Moreover, when a packet filter 11 to which the parameter is set is designated, the parameter is set to the packet filter 11. Alternatively, the same effect can be obtained by retrieving packet filters 11 to which a designated parameter can be set and setting the parameter to one of the packet filters 11. Each packet filter 11 selects and passes a packet input in accordance with a set parameter and transfers the packet to a memory interface 12. The memory interface 12 stores the packet in a storing area on a memory buffer 3 corresponding to the type of the input packet.

FIG. 19 is an illustration showing an example of memory assignment of the filter-setting-parameter storing memory 44 in FIG. 18. Referring to FIG. 19, the filter-setting-parameter storing memory 44 is divided into a plurality of parameter setting areas and a parameter used to set the packet filter 11 is stored in each parameter setting area.

According to the present invention, the following advantages can be obtained.

A first advantage of the present invention is that a plurality of carrying streams can be filter-processed in parallel at the same time. This is because the present invention is provided

with a packet filter for receiving inputs from a plurality of demodulating circuits and extracting only necessary information according to a designation of a user out of the received inputs, in which the packet filter judges whether a packet ID of each packet matches a previously entered packet ID, passes the packet when the packet matches the previously entered packet, and writes the passed packet in a memory buffer.

A second advantage of the present invention is that it is unnecessary to interrupt another processing of a user program by outputting a filtered result to a request from a user.

A third advantage of the present invention is that it is possible to improve the memory efficiency and reduce the memory capacity.

A fourth advantage of the present invention is that an access to a single memory space is made possible at the time of writing or reading a filtered result.

A fifth advantage of the present invention is that it is made possible to execute filtering with a single processor.

A sixth advantage of the present invention is that a result of filtering a plurality of carrying streams can be output as carrying streams by packet-dividing the result.

A seventh advantage of the present invention is that it is possible to reduce the memory capacity required to store table-type information.

An eighth advantage of the present invention is that it is

possible to reduce the memory capacity required to store combined-table-type information.

A ninth advantage of the present invention is that it is possible to improve the convenience of outside users by outputting
5 pieces of table-type information configuring combined-table-type information separately from each other.

A tenth advantage of the present invention is that a program information table based on the latest information is always realized by automatically updating the table.

10 An eleventh advantage of the present invention is that it is possible to filter a carrying packet by designating a program discriminating ID instead of designating a packet ID directly from an external unit.

15 A twelfth advantage of the present invention is that it is possible to judge in a program filter whether the information requested by a user can be obtained from a carrying stream.

A thirteenth advantage of the present invention is that, when it is judged that the information requested by a user cannot be obtained from a carrying stream, it is possible that a program
20 filter automatically changes settings of a demodulating circuit to make the demodulating circuit output a necessary carrying stream.

A fourteenth advantage of the present invention is that it is possible to apply a certain filtering condition to an optional
25 carrying stream by making it possible to set filtering conditions

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A fifteenth advantage of the present invention is that it is possible to apply a filtering condition once set to a carrying-stream output of a demodulating circuit not used at that point of time and reduce the throughput for setting filtering conditions.